1. PURPOSE

This Technical Implementing Procedure (TIP) provides instructions for the calibration of equipment (including thermocouples, flowmeters, pH meter, and pumps) and measurement of pH and air permeability at the site of the experiment for Thermo-Hydrologic Laboratory Studies at Lawrence Berkeley National Laboratory (LBNL) for supporting the Yucca Mountain Site Characterization Project (YMP).

2. SCOPE

This procedure applies to all LBNL personnel (or contractor personnel following LBNL procedures) involved in calibration and measurement activities subject to Quality Assurance Requirements and Description (QARD), DOE/RW-0333P. These activities shall be performed as described in Master Planning Document (MPD) YMP-LBNL-MPD-1.0 *Thermo-Hydrologic Laboratory Studies FY99* or applicable subsequent planning document, when this work is not covered other by YMP-LBNL-TIPs.

For all technical activities, data collected using this procedure and any equipment calibrations or recalibrations that may be required shall be in accordance with this TIP and in full compliance with YMP Administrative Procedure (YAP)-12.3Q, *Control of Measuring and Testing Equipment and Calibration Standards.* Documentation resulting from actions taken under this TIP will be recorded in Scientific Notebooks as described in the Office of Civilian Radioactive Waste Management (OCRWM) Administrative Procedure (AP)-SIII.1Q, *Scientific Notebooks*. Measurements and calibrations of other equipment not specifically mentioned herein will be in full compliance with YAP-12.3Q. Electronic data maintenance, controls and transfers shall comply with YMP-LBNL-Quality Implementing Procedure (QIP)-SV.0, *Control of the Electronic Management of Data.*

If this procedure cannot be implemented as written, YMP-LBNL personnel shall notify the responsible Principal Investigator (PI) or designee. If it is determined that a portion of the work cannot be accomplished as described in this TIP, or would produce undesirable results, that portion of the work shall be stopped and not resumed until this procedure is modified per YMP-LBNL-QIP-5.2, *Preparing Development Plans & Quality /Technical Implementing Procedures*.

If the responsible PI or designee determines that a modification or a revision to the TIP would cause an unreasonable delay in proceeding with the task, then an expedited change to the procedure, including documentation of deviation from the approved procedure, can be made according to YMP-LBNL-QIP-5.2. Such changes are subject to review, usually after the task has proceeded, and thus work performed under TIPs with expedited changes is done at risk of future invalidation.

Employees may use a controlled electronic or hard copy of this procedure; however, employees are responsible for assuring that the correct revision of this procedure is used. When this procedure becomes obsolete or superseded, it shall be destroyed or marked "superseded" to ensure that this document is not used to perform work.

3. PROCEDURE

The following sections address specific categories described for calibration and usage logging in YAP-12.3Q.

3.1 Establishment of Standards

For calibration of Measuring and Testing Equipment (M&TE) in accordance with this TIP, the PI or designee shall obtain the M&TE calibration standards pertaining to the equipment identified in Sections 3.2.1. through 3.2.5 below that have traceability to nationally recognized standards (e.g. National Institute of Standards (NIST) as required by YAP 12.3Q. The PI shall complete a M&TE Justification Form for the established standards identified below for each piece of equipment in accordance with YAP-12.3Q. This form shall be filed in the scientific notebook.

3.2 Calibration Procedures and Usage Logs

Specific calibration requirements described in YAP-12.3Q are listed below. Additional details are provided in the identified sections.

3.2.1 Thermocouple Calibration (See Section 3.3)

a) Identification of standards to be used: see Section 3.3.

b) Detailed description of calibration method: see Section 3.3.1 to 3.3.6.

c) Consideration of manufacturer's recommendations for storage and handling:

Thermocouples are manufactured by attaching two dissimilar metals together. Corrosion, which is temperature dependent, causes a potential between the metals. Thus, thermocouples shall not be stored or handled in a manner which adversely affects the connection of these metals or enhances corrosion.

d) Identification of tolerances and ranges of use:

The thermocouple accuracy will be no better than that of the thermometer the thermocouple is calibrated to. Because of linearity of the thermocouple response (See Section 3.3) thermocouples may be used outside of their calibration range but shall not be used further outside their range than the temperature difference between the lowest and highest calibrating temperatures.

e) Identification of calibration intervals:

Thermocouples shall be recalibrated every six months. Thermocouple calibration verification checks may be performed more frequently, or if unusual data cause the thermocouple data to be called into question.

3.2.2 Bubble Flow Meter Calibration (See Section 3.4)

a) Identification of standards to be used:

A balance calibrated according to YMP-LBNL-TIP / AFT1.0, *Balance Calibration*, shall be used.

b) Detailed description of calibration method: see Section 3.4.1 to 3.4.2.

c) Consideration of manufacturer's recommendations for storage and handling:

The bubble flow meter is a glass tube and shall be handled and stored in such a manner as not to break it or heat it such that the glass softens.

d) Identification of tolerances and ranges of use:

Flowmeter tolerance shall be determined from the calibration curve. The lower limit of use is determined by the bubbles popping prior to advancing a measurable distance, the upper limit of use is limited by bubbles popping and human reaction time to measure the time of bubble travel.

e) Identification of calibration intervals:

The bubble flow meter is a stable glass tube, thus once calibrated, this M&TE never requires recalibration.

3.2.3 Cole Parmer Variable Area Flow Meter Calibration (See Section 3.5)

a) Identification of standards to be used:

A Bubble Flow Meter calibrated according to this TIP shall be used.

b) Detailed description of calibration method: see Section 3.5.1 to 3.5.6.

c) Consideration of manufacturer's recommendations for storage and handling:

M&TE shall not be handled in a manner which adversely affects its current or future performance. The flow meter shall be stored indoors at room temperature, and shall not be handled in such a manner that causes breakage or buildup of static charge, or use of excessively dirty or oily gas feedstreams.

d) Identification of tolerances and ranges of use:

Flowmeter tolerance shall be determined from the calibration curve. The flow meter shall be used only within the range calibrated, and only within the range where standard indications are present on the variable area tube.

e) Identification of calibration intervals:

This M&TE requires recalibration following cleaning or if dirt or liquids accumulate on the sapphire float or coat the tubing.

3.2.4 pH Meter Calibration (See Section 3.6)

a) Identification of standards to be used:

See Section 3.6. Off-the-shelf buffers accurate to 0.01 pH units or better with NIST traceability are required. Certificates of Analysis are required showing the comparison between the lot and the primary standard obtained from NIST.

b) Detailed description of calibration method: See Attachment 1.

c) Consideration of manufacturer's recommendations for storage and handling:

M&TE shall not be handled in a manner which adversely affects its current or future performance. The pH meter shall be stored indoors at room temperature, and shall not be handled in such a manner that causes breakage. Solutions shall not be excessively stirred using the electrode, and the electrode shall be stored in electrode storage solution between uses.

d) Identification of tolerances and ranges of use:

pH meter tolerance shall be assumed to be equal to the tolerances of the standard solutions bracketing a particular measurement.

e) Identification of calibration intervals:

The pH meter shall be recalibrated prior to each use.

3.2.5 Pump Calibration (See Section 3.7)

a) Identification of standards to be used:

A balance calibrated according to YMP-LBNL-TIP / AFT1.0 Balance Calibration shall be used.

b) Detailed description of calibration method: see Section 3.7.1 to 3.7.8.

c) Consideration of manufacturer's recommendations for storage and handling:

M&TE shall not be handled in a manner which adversely affects its current or future performance. If pumps are used to pump solutions that are visibly cloudy or contain visible particles, upstream line filtration is required using filters rated at 10 microns or smaller. Pumps shall be rinsed out with distilled water and isopropyl alcohol and drained prior to storage.

d) Identification of tolerances and ranges of use:

Pump tolerance shall be determined from the calibration curve.

e) Identification of calibration intervals:

Pump recalibration is required following pump disassembly, or when pump calibration data is used to generate quality-affecting data.

3.2.6 Documentation:

The Staff Member shall document the following information in the Scientific Notebook or the M&TE Calibration Documentation Form (Attachment 2) for each piece of equipment described in Sections 3.3.1 through 3.3.5:

a) The unique identification of the M&TE calibrated

b) Date calibrated

c) Calibration data, results of the calibration, and statement of acceptability

d) Re-calibration due date or calibration interval / frequency

e) Procedure (including revision level) used to calibrate the M&TE

f) Identification of and traceability to the calibration standards used for the calibration

g) As-found condition of the M&TE, as appropriate

h) Specified range and tolerances and whether the M&TE met those tolerances

i) Personnel performing calibrations

j) Reference to actions taken with out-of-calibration or non conforming M&TE, including evaluation results, as appropriate

The M&TE Calibration Documentation Form (Attachment 2) may be used to document the above. If used, it shall be filed in the scientific notebook.

3.2.7 Controls for nonconforming or out-of-tolerance conditions:

Nonconforming or out-of-tolerance equipment shall be segregated or tagged with an Out-of-Service tag in accordance with YAP-12.3Q and not be used. Recalibration shall be attempted to remedy the nonconformance. If this is ineffective, the nonconforming equipment shall be replaced if possible. If replacement is impossible or the replacement timeframe is such that sample degradation will occur rendering samples useless, nonconforming equipment may be used with notification of the PI and an evaluation of the effects of using such equipment on the data is performed and documented on the M&TE Out of Calibration Report (OCR) as described in YAP-12.3Q. The OCR shall be filed in the scientific notebook. If it is determined that the data is impacted, a Nonconformance Report (NCR) shall be initiated in accordance with YAP-15.1Q.

3.2.8 Recalibration when updates to software affects calibration:

Not applicable.

3.2.9 Staff Member shall document each usage of the equipment on the

M&TE Standard Usage Log as described in YAP-12.3Q and file the form in the scientific notebook.

3.3 Thermocouple Calibration

A thermometer properly calibrated by a vendor on the QSL as required by YAP-12.3Q is used as the standard against which thermocouples are calibrated. A two-point calibration of thermocouples (Type K, Omega Engineering) shall be performed. The thermocouples are connected to a Validyne UPC 601U card installed inside a personal computer. Validyne Easy Sense software, an integral part of the equipment, is used to interpret results and for calibration. Linearity is assumed both within and outside of the interpolation range based on plotting Type K thermocouple voltage outputs tabulated by the National Bureau of Standards across the temperature range of interest (0-400°F, Holman, J.P., 1978, p281, Table 8-3, also 2.64-200°C, Omega Engineering, Table 4, p Z-18, 1998) and fitting the resulting plots with lines having r^2 values (indicating goodness of fit, with 1.00 showing a perfect correlation and 0 showing no correlation) of 1.0 and 0.9999.

3.3.1 Connect the thermocouples to the data acquisition system.

3.3.2 Set up two water baths of appropriate temperatures. For example, if thermocouples are used to measure temperatures near the water boiling point, one of the baths may be boiling water. The other bath should be at an easily maintained reasonable temperature such as room temperature or ice water. Monitor and record the temperatures of the baths using a properly calibrated thermometer.

3.3.3 Set the units of measure in the Easy Sense Setup software to “User Defined.”

3.3.4 Place a thermocouple in a cool bath (either at room temperature or ice water), enter the bath temperature read from the thermometer into the computer, and allow the output signal to be acquired by the data acquisition system. Place the thermocouple in a hot bath (boiling water), enter the temperature of the bath into the computer, and allow the output signal to be again acquired by the data acquisition system. Follow the procedure as prompted by the computer and repeat for each thermocouple.

3.3.5 Save the setup using the Easy Sense software. Record slopes and offsets displayed by Easy Sense in the scientific notebook.

3.3.6 If an Easy Sense system is not available, either the voltage or temperature outputs of the thermocouples can be plotted against the known temperatures to obtain a linear calibration. This is exactly equivalent to the procedure specified in 3.3.1 through 3.3.5. Calibration data collected shall be recorded in the scientific notebook.

3.4 Flow Meter Calibration (Bubble Flow Meter)

The bubble flow meter operates on the concept that the time a soap film bubble takes to travel through a known volume can be measured. The gas flow rate can thus be calculated by dividing the volume through which the bubble traveled by the time. The volumes indicated by the bubble flow meter requires calibration. Time is measured on a stopwatch.

3.4.1 Plug the bottom ports of the bubble flow meter and fill with water to the zero volume marker (or slightly above) and record the level of the water using the labels on the bubble flow meter. Measure the weight of the flowmeter, water, and support on a properly calibrated balance. Record the water levels and masses in the scientific notebook. Add more water and again record the level of the water and the mass. Continue adding small volumes of water (~1 ml) at least 20 times until the water level exceeds the highest volume marker.

3.4.2 From each mass recorded, subtract the mass recorded for the near-zero level. Divide the resulting masses by the density of water at the temperature of water used measured with a properly calibrated thermometer (water density is tabulated in the CRC Handbook of Chemistry and Physics, e.g. [Lide, 1990]). For each level recorded, subtract the recorded near zero level (volume indicated by the bubble flow meter). Plot the volume of water calculated by taking the mass and dividing by the density against the volume indicated by the bubble flow meter. The resulting plot is a calibration curve providing the measured volume versus the indicated volume. The calibration plot shall be placed in the scientific notebook.

3.5 Calibrate Cole Parmer Variable Area Flow Meter

A bubble-flow meter calibrated in accordance with this TIP is used as the standard against which variable flow meters are calibrated.

3.5.1 Connect the variable area Cole Parmer (CP) Flowmeter [150 mm Easy-View Correlated Flowmeter, 150 ml/min. maximum (air), sapphire float] to an air supply and the bubble flow meter, such that the bubble flow meter discharges to the atmosphere.

3.5.2 Induce flow through the meters using the control valve on the variable area flowmeter. Record the line number (indication) at the center of the ball in the scientific notebook.

3.5.3 Squeeze the rubber bulb on the bubble flow meter to generate a bubble. Start the stopwatch (begin timing) the bubble when it crosses a marker selected for reference. Stop timing when the bubble passes the second selected reference marker. If possible, the volume between the two references should be the maximum allowed by the bubble flow meter (25 ml). For very low flow rates, smaller volumes may be selected at the discretion of the PI or designee.

3.5.4 Calculate the flow rate by quantifying the volume based on the calibration performed according to Section 3.4 between the two markers, and dividing this volume by the time measured.

3.5.5 Induce flow randomly at higher and lower flow indications and repeat steps 3.5.2 through 3.5.4 until sufficient data have been collected to describe the flowmeter performance.

3.5.6 Plot variable flow meter indications against measured flow rates to generate the calibration curve. The calibration curve shall be placed in the scientific notebook.

3.6 pH Meter Calibration

Calibrate pH meter (Cole Parmer pH/mV/°C Benchtop Meter, Model 59003-00, SN EP1000/8224) at a minimum of two points according to the pH meter manufacturer's guidelines (Attachment 1. The Cole-Parmer pH/mV/ °C Benchtop Meter, p. 12). For the pH values expected, standard buffers of pH 7 and 4 shall be used. A buffer of intermediate pH may be used to check the calibration. If pH values sufficiently outside this range are encountered, another buffer (e.g. pH 1 or pH 10) shall be obtained to bracket the measurement.

3.7 Pump Calibration

Pumps are used in this experiment to flow water (1) through the Tuff Dissolution Column and (2) into the Fracture Assembly . Accurate flow is necessary to provide data for mass balance. The pumps function by a piston forcing the pumped fluid through a one-way valve. The high pressure liquid chromatography pump is controlled by adjusting the stroke length using a micrometer on the pump housing. The syringe pump is controlled using a programmable electronic controller which adjusts the piston travel rate.

3.7.1 Assemble pumps or check pump assembly to verify that inlet and outlet tubing is present and not leaking. Also verify that water can flow through the pump by carefully drawing water from the outlet with a syringe or operating the pump.

3.7.2 Prime pumps, if necessary, by drawing water through them with a syringe and allow pump to run until water fills the effluent line connected to the pump, and then turn pump off. Inspect lines for bubbles and run or re-prime as necessary until bubbles are removed from the lines. Syringe pumps do not require priming.

3.7.3 Pre-weigh an appropriately sized beaker (50 - 100 ml) and record the weight in the scientific notebook.

3.7.4 Using the micrometer or pump controller, set the pump stroke to a desired location or flow rate.

3.7.5 At a reference time, (for example, 3:01:10), turn the pump on and capture the pump output in the pre-weighed beaker for a specified amount of time (5 minutes, to 2 hours or so, enough time for the pump to deliver 20 mL or more). At the second reference time (for example, 3:06:23), turn the pump off. Record the starting time, finishing time, and time the pump was operating (in our example 3:06:23 - 3:01:10 = 0:05:13 or 313 seconds) in the scientific notebook.

3.7.6 Weigh the beaker and water. Subtract the initial weight (of the beaker), and divide the resultant mass by the density of water at the laboratory conditions to determine the volume (water density is tabulated in the CRC Handbook of Chemistry and Physics, e.g. [Lide, 1990]). Divide the volume by the time the pump was operating to determine flow rate. Record all volume and time data in the scientific notebook.

3.7.7 Repeat for several micrometer or flow rate settings, particularly near the flow rate of interest, and plot the flow rate against the micrometer setting. A minimum of three micrometer settings in the neighborhood of the flow rate of interest is required. Since backlash in micrometer settings may occur during setting the pump, a sequence of micrometer settings shall include at least one setting in the reverse direction. This will allow for observation of backlash effect. If there is a noticeable backlash effect, settings shall be approached from the same direction, and a sticker shall be affixed to the pump identifying that direction.

3.7.8 Flow verifications may be performed during the course of the experiment using shorter duration measurements as required by experimental needs to be determined by the PI or designee.

3.8 pH Measurement

pH measurements shall be made according to the pH meter manufacturers guidelines (Attachment 1). The Cole-Parmer pH / mV / °C Benchtop Meter, p. 14). pH readings shall be recorded in the scientific notebook every 30 seconds until stable readings are obtained.

3.9 Air Permeability Measurement

The fracture permeability will be measured prior to and following the heating and flow of water. Flow through the fracture and pressures at the fracture inlet and outlet are required. Permeability will be calculated by the following relation (rearranged from Equation 5.2.1.6, Scheidegger, 1974, p. 102):

$$k = \frac{-2\mu q_o x p_o}{p_x^2 - p_o^2} \quad (1)$$

where k is permeability (L^2), μ is the viscosity ($ML^{-1}T^{-1}$), p_o is the pressure ($ML^{-1}T^{-2}$) at location o (inlet), p_x is the pressure at location "x" (outlet). q_o is the seepage velocity (LT^{-1}) at location "o", calculated by dividing the measured flow rate by nominal area for flow (here defined by the nominal aperture multiplied by the width of the fracture perpendicular to the flow direction). Conditions at "o "and "x" may be interchanged with no ill effect. A schematic is presented in Attachment 3.

3.9.1 Connect the inlet of the variable area flow meter to an air supply.

3.9.2 Connect the outlet of the variable area flow meter to the inlet fracture-assembly end cap.

3.9.3 Connect the outlet fracture-assembly end cap to the bubble flow meter with bubble flow meter outlet to the atmosphere.

3.9.4 Connect a properly calibrated pressure gauge or manometer end to the inlet fracture assembly end cap.

3.9.5 Connect a second properly calibrated pressure gauge or other manometer end to the outlet fracture assembly end cap.

3.9.6 Using the control valve on the variable area flow meter, introduce air flow through the fracture assembly. Allow the air flow to stabilize.

3.9.7 Once the air flow has stabilized, record the pressures indicated at each end of the fracture and the air flow rate measured using the bubble flow meter in the scientific notebook.

3.9.8 Change the air flow rate by adjusting the control valve on the variable area flow meter and repeat the measurement for several flow rates.

3.9.9 Evaluate the data according to Equation 1 and place the results in the scientific notebook. The slope of the plot of q_0 versus $(p_x^2-p_0^2)$ is equal to $k/(2\mu x p_0)$.

4. RECORDS

4.1 Lifetime

Records generated as a result of this TIP are entries in:

- Scientific notebooks or attachments to such notebooks,
- Equipment Logbooks (including MT&E Justification Forms and Standard Usage Log)
- MT&E Out of Calibration Reports, if applicable.

4.2 Non-Permanent

None

4.3 Controlled Documents

This Technical Implementing Procedure

4.4 Records Center Documents

Records associated with this procedure shall be submitted to Records Processing Center in accordance with AP-17.1Q, *Record Source Responsibility for Inclusionary Records*.

5. RESPONSIBILITIES

5.1 The **Principal Investigator (PI)** is responsible for assuring full compliance with this procedure and providing training thereof. The PI is responsible for overseeing and coordinating TIP preparation, review, distribution, revision, and recommendation of rescission.

5.2 **Staff Members** involved in the preparation or review of procedures are responsible for following this procedure and turning over related documentation to the Records Coordinator for submittal to the Records Processing Center in accordance with AP-17.1Q. Related data shall be turned over to Technical Data Coordinator for submittal to YMP Technical Data Management System (TDMS) in accordance with and AP-SIII.3Q, *Submittal and Incorporation of Data to the Technical Data Management System*.

6. ACRONYMS AND DEFINITIONS

6.1 Acronyms

AP	OCRWM Administrative Procedure
EA	Engineering Assurance
LBNL	Lawrence Berkeley National Laboratory
M&TE	Measuring and Testing Equipment
NCR	Nonconformance Report
NIST	National Institute of Standards and Technology
OCR	Out of Calibration Report
OCRWM	Office of Civilian Radioactive Waste Management
OQA	Office of Quality Assurance
PI	Principal Investigator
QIP	Quality Implementing Procedure
QSL	Qualified Suppliers List
TIP	Technical Implementing Procedure
TDMS	Technical Data Management System

YAP YMP Administrative Procedure

YMP Yucca Mountain Site Characterization Project

6.2 Definitions

Measuring and Testing Equipment (M&TE): Devices or systems used to calibrate, measure, gage, test, or inspect in order to control or acquire data to verify conformance to specified requirements (QARD).

Staff Member: Any scientist, engineer, research or technical associate, technician, or student research assistant performing quality-affecting work for YMP-LBNL.

Technical Implementing Procedure: Each TIP describes YMP-LBNL technical and/or scientific tasks that (1) are repetitive, (2) are standardized, and (3) can return different results if deviation from the sequence of steps occur.

7. REFERENCES

AP-17.1Q, *Record Source Responsibility for Inclusionary Records*

AP-SIII.1Q, *Scientific Notebooks*

AP-SIII.3Q, *Submittal and Incorporation of Data to the Technical Data Management System*

DOE/RW-0333P, *Quality Assurance Requirements and Description (QARD)*

Holman, J.P., Experimental Methods for Engineers, McGraw-Hill Book Company, 1978

Lide, D.R., CRC *Handbook of Chemistry and Physics*, 71st ed., 1990-1991, CRC Press, Inc.

Omega Engineering, The Temperature Handbook, 21st Century Preview Edition, 1998

Scheidegger, A.E., *The Physics of Flow Through Porous Media*, University of Toronto Press, 1974

YAP-12.3Q, *Control of Measuring and Test Equipment and Calibration Standards*

YAP-15.1Q, Control of Nonconformances

YMP-LBNL-MPD-THL-1.0, *Thermo-Hydrologic Laboratory Studies FY99*

YMP-LBNL-QIP-5.2, *Preparing Development Plans & Quality/Technical Implementing Procedures*

YMP-LBNL-QIP-SV.0, *Control of the Electronic Management of Data*

8. ATTACHMENTS

Attachment 1. The Cole-Parmer pH / mV / °C Benchtop Meter, 59003-00, 59003-05, 59003-10, 59003-15, 294, 1993, 48 pages

Attachment 2. M&TE Calibration Documentation Form, 1 page

Attachment 3. Permeability Measurement Schematic, 1 page

9. REVISION HISTORY

7/30/99, Revision 0, Modification 0

Initial issue.

12/03/99, Revision 1, Modification 0

Revised procedure to meet the YAP-12.3Q requirements and to incorporate references to other applicable APs and YMP-LBNL-TIPs.

10. APPROVAL

Signature on file

Preparer: T. J. Kneafsey Date:

Signature on file

Technical Review: P. Persoff Date:

Signature on file

Technical Review: Q. Hu Date:

Signature on file

EA Reviewer: N. Aden-Gleason Date:

Signature on file

OQA Concurrence: S. Harris Date:

Signature on file

Principal Investigator: K. Pruess Date:

Signature on file

Project Manager: G. S. Bodvarsson Date:

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

NOTICE:

SPECIAL HANDLING INSTRUCTIONS

QA: N/A

Document Identifier: YMP-LBNL-TIP/TT 12.0

Document Title: Att. 1: Cole-Parmer pH/mV/RelmV/C Benchtop Meter, 48 p.

Document Revision/Change: R1M0

Document Date: 12/3/1999

This document requires special handling in accordance with AP-6.1Q.

- [x] **Do NOT copy without permission.**
- [x] **Do NOT image or post online. This manual is available in the EA office in 90P.**
- [ ] **Place in a locked file cabinet or in a locked office when not attended.**

Measuring and Test Equipment (M&TE) Calibration Documentation Form

<table>
<tr><td>a) M&TE Description</td><td>b) M&TE Unique Identification</td><td colspan="2">c) Calibration Date and Time (if applicable)</td></tr>
<tr><td colspan="2">d) Person Performing Calibrations</td><td colspan="2">e) M&TE Condition (As-Found)
Working ________

Not Working ________</td></tr>
<tr><td colspan="2">f) Calibration Procedure (including revision level)</td><td colspan="2">g) Calibration Standards Used</td></tr>
<tr><td colspan="2">h) Location of Calibration Data

YMP-LBNL-___________
Page(s)</td><td colspan="2">i) Location of Calibration Results

YMP-LBNL-___________
Page(s)</td></tr>
<tr><td colspan="4">j) Statement of Acceptability including Acceptability of Range and Tolerances
Range Acceptable Yes _____, No _____
Tolerance Acceptable Yes _____, No _____
Calibration Acceptable Yes _____, No _____
Comment:</td></tr>
<tr><td colspan="4">k) Specified Range and Tolerances</td></tr>
<tr><td colspan="2">l) Re-calibration due date or calibration interval/frequency</td><td colspan="2">m) Reference to actions taken with out-of-calibration or non conforming M&TE, including evaluation results, as appropriate

YMP-LBNL-___________
Page(s)</td></tr>
<tr><td colspan="4">n) Comments</td></tr>
</table>

____

Signature Date

Permeability Measurement Schematic